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Comparison of Pulsed Electron Deposition and Pulsed Laser Deposition of selected materials

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Pulsed Electron Deposition (PED) is a method of creating thin films through ablation at low pressure that has many similarities to Pulsed Laser Deposition (PLD). Key advantages of PED include lower equipment cost and higher energy efficiency. We have investigated the use of PED as an alternative to PLD for production of the new solar cell material copper zinc tin sulfide (CZTS). Measurements of the electron energy distribution of the PED pulses at different discharge voltages are compared to the composition of the resulting films and to the influence of laser fluence on film composition with PLD. There is a similar deviation from the target stoichiometry depending on fluence/electron energy with the two techniques. Additionally, droplets occur with both techniques with a strong reduction in droplet density at low energy/low fluence. Finally the desired lattice structure of crystalline CZTS is obtained at a relatively low temperature around 300 °C with both techniques and the deposition rate for PED is at least as fast as PLD with a 248 nm excimer laser or a 355 nm Nd:YAG laser. The beam-target interaction of PED versus PLD is discussed and our results for CZTS are compared with PED and PLD production of ZnS and CIGS. Overall, we find that PED is able to produce films in a similar manner to PLD with both techniques requiring some fine tuning of the deposition parameters for good-quality films.